consistent with this correlation. Appreciable absorption of light in extra-galactic space appears to be inadmissible.

(E) The limiting magnitude for the counts on exposures of one hour with the 100-inch is estimated as 19.8, hence the number of nebulae per square degree is given by the relation

$$\log N_{sd} = 0.6\, m_{pg} - 9.5$$

This, combined with the value -13.8 for the mean absolute photographic magnitude of nebulae, leads to a mean density of the order of one nebulae per 6×10^{16} cubic parsecs. A provisional value for the mean mass of nebulae, 5×10^{8} times the mass of the sun, suggests 5×10^{-31} gm/c.c. as the order of the mean density of nebular material in the observable region of space.

(F) The scanty data available suggest that, in the regions of normal distribution, one cluster of nebulae which would be recognized as such on exposures of one hour, may be expected per 30 square degrees. This frequency is tentative and depends largely upon the criteria selected for defining a cluster.

The distribution of nebulae appears to be approximately uniform out to the limits of the largest telescope available, except in so far as it is affected by partial or complete obscuration by diffuse material within the galactic system. Great clouds of the latter material are known to exist; in fact, the pattern of obscuration along the Milky Way seems to account for many or most of the "star clouds." Evidence from the nebulae concerning a uniformly diffused substratum within our own system is contradictory. In favor of the hypothesis is the fact that, in the general direction of the center, the counts of nebulae are affected out to latitudes $\pm 40°$, the occasional late type spirals in low latitudes with abnormally faint surface brightness; and the color-excess exhibited by members of the Perseus cluster of nebulae at lat. $-13°$. For these facts a diffuse substratum offers a possible although not a necessary explanation. Against the hypothesis are the approximately normal colors among nebulae in low latitudes and longitudes 10° to 50°, the normal surface brightness of late type spirals in the same region at latitudes as small as 8°, and the fact that for the 8 nebulae within 20° of the galactic plane whose spectra are available, the absolute magnitudes corresponding to distances indicated by the red shifts average brighter than normal. Extensive observations will be required for a definite conclusion. Obscuring clouds are familiar, but a diffuse substratum can be investigated only when the effects of the clouds can be ascertained and eliminated.

EDWIN P. HUBBLE

MT. WILSON OBSERVATORY

THE HEMOGLOBIN CONTENT OF THE BLOOD OF THE HEN: A STATISTICAL STUDY OF INFLUENCES AND RELATIONS

IN another communication[1] results were presented of a study of the hemoglobin content of the blood of chickens and wild fowls. The method of hemoglobin determination was that of Newcomer. A correction was introduced for at least the greater part of the turbidity of the acid hematin solutions prepared from bird blood for hemoglobin determination by the Newcomer method. The correction formula is

$$C = 0.91U - 1.49,$$

where C is the corrected reading and U the uncorrected reading.

Table 1 shows the hemoglobin content of the blood of the hens and the pullets studied.

TABLE 1

MEAN HEMOGLOBIN CONTENT OF THE BLOOD OF HENS AND PULLETS

	Number of individuals	Uncorrected hemoglobin	Corrected hemoglobin
		gm per 100 cc	*gm per 100 cc*
White Leghorn hens	101	12.8 ± 1.0	10.2 ± 0.9
White Plymouth Rock hens	101	12.3 ± 0.8	9.8 ± 0.7
Rhode Island Red hens	102	11.9 ± 0.7	9.4 ± 0.7
White Leghorn pullets	101	11.4 ± 0.7	8.9 ± 0.7

The data in this table indicate breed differences, and one purpose of this paper is to present the results of a statistical study made to determine if such differences are significant.

Since data on the age of the birds at the time of making the hemoglobin measurements, on the age at maturity and on the spring egg production were available through the cooperation of the College Poultry Husbandry Department and the dates of making the hemoglobin measurements were known, it was deemed worth while to make a statistical study of the correlation between hemoglobin and these different factors. A presentation of these results is the second purpose of this paper.

For the purposes of this statistical study it is immaterial whether corrected or uncorrected hemoglobin readings be used. The latter readings are used in all instances.

The statistical constants were calculated according to the method given by Wallace and Snedecor.[2]

[1] H. H. Dukes and L. H. Schwarte, *Amer. Jour. Physiol.*, 96: 89–93, 1931.

[2] H. A. Wallace and G. W. Snedecor, "Correlation and Machine Calculation," Official Publication, revised edition. Iowa State College, Ames, Iowa, 1931.

INFLUENCE OF BREED

The mean hemoglobin content of the blood of the hens of various breeds is shown in Table 1. In Table 2 are shown the mean differences in hemoglobin content by breeds, the probable errors of the mean differences and the ratios of mean differences to probable errors. The mean differences by breed are uncorrected for age and age at maturity. It will be noted that all the differences are statistically significant.

TABLE 2

DIFFERENCES BY BREED IN THE MEAN HEMOGLOBIN CONTENT OF THE BLOOD OF HENS

	Rhode Island Red hens			White Plymouth Rock hens		
	Mean Hb difference	PE	Ratio	Mean Hb difference	PE	Ratio
	gm per 100 cc			*gm per 100 cc*		
White Leghorn hens	0.9	0.12	7+	0.5	0.12	4+
Rhode Island Red hens				0.4	0.11	3+

When the mean differences shown in Table 2 are corrected for age and age at maturity, they are still found to be significant.

INFLUENCE OF AGE

The hemoglobin content of the blood of chicks is between six and seven gm per 100 cc.[3] Evidently at this period in the life of the chicken age has a considerable influence on the hemoglobin content of the blood.

The mean hemoglobin content of the blood of White Leghorn pullets ranging in age from about four to six months is 11.4 ± 0.7 gm per 100 cc. The mean of White Leghorn hens is 12.8 ± 1.0 gm per 100 cc (Table 1). The difference is 1.4 ± 0.12 gm per 100 cc, which is highly significant. The data also furnish information on the influence of age on the hemoglobin content of the blood of hens. The mean age of all hens was 658 ± 10 days; the mean hemoglobin content of the blood, 12.3 ± 0.1 gm per 100 cc. The correlation between age and hemoglobin was found to be 0.21. The number of hens included in this study is approximately 300. With a number as large as this a correlation coefficient of 0.21 is, according to Fisher's tables,[2] highly significant.

[3] E. B. Hart, C. A. Elvehjem, A. R. Kemmerer and J. G. Halpin, *Poultry Sci.*, 9: 92–101, 1930.

CORRELATION BETWEEN SEASON AND HEMOGLOBIN CONTENT

There is a wide-spread popular belief that the blood of animals is "thicker" in the winter than in the summer. Furthermore, there is a good deal of evidence[4] tending to show that external heat causes a dilution of the blood. The present data are suggestive in this connection, in that they indicate that with the approach of winter the hemoglobin content of the blood increased significantly. Thus the mean date of the hemoglobin determinations in hens was 39.4 ± 0.25 weeks after January 1, that is, the second week of October; and the correlation between the date of determination (season) and the hemoglobin content of the blood was found to be 0.20.

CORRELATION BETWEEN AGE AT MATURITY AND HEMOGLOBIN CONTENT

The mean age of all hens at maturity (date of laying first egg) was 207 ± 2.0 days. The correlation between age at maturity and the hemoglobin content of the blood was found to be -0.16, which also is highly significant.

CORRELATION BETWEEN SPRING EGG PRODUCTION AND HEMOGLOBIN CONTENT

Since spring egg production is a part of yearly egg production, these show a high positive correlation. Therefore a determination of the correlation between spring egg production and the hemoglobin content of the blood would give information about the correlation between the annual egg production and hemoglobin.

The mean production of all hens for the spring of 1929 was 59 ± 1.0 eggs. The correlation between spring egg production and the hemoglobin content of the blood was found to be 0.08, which is not significant.

H. H. DUKES,
L. H. SCHWARTE,
DEPARTMENT OF VETERINARY INVESTIGATION
A. E. BRANDT
DEPARTMENT OF MATHEMATICS,
IOWA STATE COLLEGE

BOOKS RECEIVED

BROTEMARKLE, ROBERT A. *Clinical Psychology.* Pp. xxi + 409. University of Pennsylvania Press.

JOHNSON, DOUGLAS. *Stream Sculpture on the Atlantic Slope.* Pp. xxii + 142. 21 figures. Columbia University Press. $3.25.

MICHALSKI, S., Editor. *Science and Letters in Poland.* Vol. XIV. Pp. x + 404. Institute for the Promotion of Science and Letters in Poland, Warsaw.

PRATT, CARROLL C. *The Meaning of Music.* Pp. viii : 253. McGraw-Hill. $2.00.

ROBERTSON, T. BRAILSFORD. *The Spirit of Research.* Pp. xvi + 210. Preece & Sons, Adelaide.

[4] H. G. Barbour, *Physiol. Rev.*, 1: 295–326, 1921.